HARDCOPY SERVICING APPARATUS

Field of the Invention

The present invention relates generally to hardcopy devices, particularly but not exclusively to inkjet printers and to apparatus for servicing such devices.

Background to the Invention

As is well known in the art, conventional inkjet printers generally employ one or more inkjet cartridges, often called "pens", which eject drops of ink onto a page or sheet of print media. For instance, two earlier thermal ink ejection mechanisms are shown in U.S. Patent Nos. 5,278,584 and 4,683,481, both assigned to Hewlett-Packard Company. The pens are usually mounted on a carriage, which is arranged to scan across a scan axis relative to a sheet of print media as the pens print a series of individual drops of ink on the print media. The series of drops collectively form a band or "swath" of an image, such as a picture, chart or text. Between scans, the print medium is advanced relative to the scan axis. In this manner, an image may be incrementally printed.

Generally, ink is provided in replaceable ink containers or supplies, which are designed to interface with the printer. Such ink supplies are sometimes provided in a range of different volumes. In this way a user may select the volume of an ink supply in dependence upon the expected usage rate. If the volume is too small, it will require frequent replacement. If, on the other hand, the volume is too large, it may reside in the printer for a period of time that exceeds the shelf life of the ink. Thus, in the case of a high throughput inkjet printer, for example, suitable ink supplies may be available in a range of volumes such as 0.2 to 1.0 litres.

In printer systems which are adapted to be used with varying sizes of ink containers, it is often viewed as desirable, in order to save space and expense, to ensure that the same ink container interface associated with the printer system may be used with various differently sized ink containers. In order to allow both small and large volume ink containers to be installed in a printer system, it is known to use a spacer, or

interconnecting part to facilitate the installation of the small volume ink containers. In such systems, however, the user must usually buy one or more interconnecting parts. Such interconnecting parts represent an inconvenience for many users, since they may be difficult to use. Furthermore, such interconnecting parts must be stored while they are not being used and during such times they may be lost or damaged.

Another known way of supplying such ink containers or supplies having a range of different volumes is to market a single size of ink supply container but filled with ink to varying degrees. In this manner, high volume users may purchase fully filled ink supply containers and lower volume users may purchase partially filled ink supply containers. In this manner, each user may purchase the volume of ink that he or she desires. However, such an approach is relatively wasteful both in terms of the material that is used to manufacture the ink supply containers that are only partially filled and in terms of space that is required to store them.

It would therefore be desirable to provide a hardcopy device, or servicing apparatus for use in a hardcopy device, which addresses one or more problems encountered in the prior art.

Summary of the Invention

According to one aspect of the present invention there is provided an ink reservoir adaptor for use in a hardcopy device, comprising a reservoir supporting element movable relative to the adaptor between first and second positions, the supporting element being arranged in the first position to receive a reservoir, the supporting element being further arranged, when moved to the second position, to bring an interface associated with the reservoir into a predetermined position relative to the adaptor.

Advantageously, embodiments of the present invention allow an ink reservoir to be easily installed for use. A user may locate an ink reservoir relative to the supporting element whilst the element is in the first position, and then correctly install the reservoir by moving the supporting element to the second position. Thus, any

required connections between the reservoir and the printer, such as electrical connections or fluid connections for ink supply and pressurisation of the reservoir, may be made by the simple procedure of moving the supporting element to the second position. In one embodiment, the supporting element is a slider or drawer-like apparatus, which may be moved from the first position to the second position simply by being pushed or manually inserted by a user along a predetermined path.

Such embodiments may obviate the need for the user to carry out a conventional installation operation in a confined space, which often requires significant manual dexterity. Such embodiments need not require modification of the interface between the printer or hardcopy device and the reservoir; thus allowing backward compatibility with many existing printer components and reservoirs.

In certain embodiments of the invention the supporting element may be adapted to support ink reservoirs of different sizes. In this manner, a user may locate any one of a range of different sized ink reservoirs on the supporting element, when it is located in the first position. The supporting element and the reservoirs may have mutually engaging features that ensure that each size of reservoir is located in a predetermined position relative to the supporting element. This may help the user to correctly locate each size of reservoir relative to the supporting element in a simple and intuitive manner. This feature may be used to ensure that the reservoirs will be correctly located relative to the adaptor, and thus the printer, when the supporting element is moved to the second position. In this manner, connection between the reservoir and the printer may be correctly established. In alternative embodiments, visual guides may instead be used to illustrate where or how reservoirs of given sizes should be located relative to the supporting element.

In one such embodiment of the invention, the supporting element is arranged such that the interface of each size of ink reservoir is located in the same place relative to the supporting element. In this way, the supporting element may be moved between substantially the same first and second positions to correctly connect or install each

of a range of differently sized reservoirs in a printer. Thus, this may be made to be a very intuitive operation, easily understood and implemented by the user.

Furthermore, in such embodiments the design of the interface between the ink reservoir(s) and the printer may conveniently be conventional and/or independent of the volume of the supply. Thus, conventional ink reservoirs may be used, ensuring backward compatibility with existing reservoir designs. This allows conventional features to be employed. These may include mechanical lockouts that control the type of reservoir, in terms of ink type or colour for example that may be installed in a given bay; and, thus used in a particular printhead. Additionally, such embodiments do not require the user to buy or use further interconnecting parts or interfaces in order to allow differently sized reservoirs to be correctly installed in a printer.

In certain embodiments of the invention, the adaptor has a reservoir housing or bay, with the supporting element being arranged to be located substantially outside the reservoir bay in the first position and to be located substantially inside the reservoir bay in the second position. In this manner, a reservoir may be easily mounted on the supporting element in the first position. Furthermore, a reservoir may be located with in the bay when the supporting element is located in the second position. This gives rise to the advantage that the bay may provide support for the reservoir. Conventionally, large ink reservoirs may be pressurised to 6 psi or more to facilitate the supply of ink. This may have the effect of deforming the reservoirs if they aren't suitably supported, or don't have sufficient rigidity as may be the case with large ink supplies. In this manner, in embodiments of the present invention a reservoir may be made comparatively inexpensively without a high degree of intrinsic rigidity and yet be pressurised without the risk of the reservoir walls becoming distorted.

Thus, embodiments of the present invention may be manufactured as inexpensive plastic parts and may provide flexibility to users who may use different volumes of ink supply in an easy, interchangeable manner. Furthermore, they may provide flexibility to hardcopy manufacturers by allowing different supply volumes to be usable in a given printer model or indeed the same ink supply system to be used in different printers.

The present invention also extends to corresponding hardcopy devices.

Brief Description of the Drawings

For a better understanding of the invention and to show how the same may be carried into effect, there will now be described by way of example only, specific embodiments, methods and processes according to the present invention with reference to the accompanying drawings in which:

Figure 1 is a perspective view of an inkjet printer in accordance with a first embodiment of the present invention;

Figure 2a is a perspective schematic view of the adaptor assembly illustrated in Figure 1, with high volume reservoirs in place;

Figure 2b and c show the adaptor assembly as illustrated in Figure 1, with low volume reservoirs and a mixture of high and low volume reservoirs, respectively, in place;

Figure 3 is a perspective view of conventional high and low volume ink reservoirs;

Figures 4a and 4b show the adaptor and ink reservoirs corresponding to Figures 2a and 2b respectively, with one of the sliders in its open position in each case;

Figures 5a and 5b show a cross sectional view of the open slider illustrated in Figures 4a and b, respectively; and,

Figures 6a and 6b show a cross sectional view of the slider and reservoirs illustrated in Figures 5a and 5b, respectively, but in the closed position.

Detailed Description of the Best Mode for Carrying Out the Invention

There will now be described examples of the best mode contemplated by the inventors for carrying out the invention.

First embodiment

Referring to Figure 1, an embodiment of an inkjet printer 10 according to the present embodiment is shown. The printer 10 may be used for printing conventional engineering and architectural drawings, as well as high quality poster-sized images, and the like, in an industrial, office, home or other environment.

While it is apparent that printers may vary from model to model, in the present example, the printer 10 has a printer body housed in a casing 12 and supported on a pair of leg assemblies 14. The printer 10 may be operated through user commands, input through a key-pad and status display portion 16, located on the exterior of the casing 12. Alternatively, the printer may operate in response to instructions received from a host device, such as a personal computer or a computer aided drafting (CAD) computer system (not shown).

The printer has a conventional print media handling system (not shown) that may be used to advance a sheet of print media in the form of pre-cut sheets, or from a roll 18 through the print zone 20 along the Y axis in a conventional manner. In the print zone 20 the media sheet receives ink from one or more conventional inkjet cartridges (not shown); often termed "pens" in the art. In the present embodiment, four inkjet cartridges are supported on a scanning carriage (not shown), which is arranged to travel back and forth, in the X axis, across the print zone. In the present embodiment, each of the four inkjet cartridges is arranged to print a different colour ink: black; cyan; magenta; and, yellow respectively.

A conventional inkjet cartridge servicing station 22 is located at the right hand end of the printer body 12, as viewed in the figure. The user may gain access to the servicing region 20 via an access panel 24, which is illustrated in the open position in the figure.

The printer 10 uses an "off-axis" ink delivery system. In an off-axis system, the pens may be replenished by ink conveyed through a conventional flexible tubing system (not shown) from stationary main reservoirs, which are located "off-axis" from the path of printhead travel. In this manner, only a small ink supply is propelled by carriage across the print zone. The printer 10 has an ink supply region 26, located at the left hand end of the printer body 12, as viewed in the figure. As can be seen from the figure, four stationary reservoirs 28a-d are located in the ink supply region 26. In the present embodiment, the four stationary reservoirs 28a-d supply black, cyan, magenta, and yellow ink respectively to a corresponding cartridge.

As can be seen from the figure, and as is described in more detail below, the stationary reservoirs 28a-d are removeably supported in an adaptor unit 30, which is itself supported in the ink supply region 26 of the printer 10. In this manner, when one of the reservoirs 28a-d runs out of ink, the user may replace it with a new or replacement reservoir. The user may gain access to the reservoirs via an access panel 32, which is illustrated in the open position in the figure.

Referring now to Figure 2a, a perspective view of the adaptor unit 30 is shown, removed from the printer 10. In practice, the adaptor unit 30 may be either removeably, or non-removeably mounted in the printer 10. The adaptor unit 30 has a housing 34, which may be made from any suitable material. In the present embodiment, this is a single-piece, plastic, injection moulded part. The housing 34 has four external walls forming a box structure. As represented in the figure, the external walls include an upper surface 34b, a lower surface 34a, which are arranged parallel to one another, and two side walls 34c and 34g. The side walls 34c and 34g are also arranged parallel to one another, spaced apart in the X axis, and are each connected to both the upper and lower surfaces 34a and 34b. Three further walls 34d, 34e and 34f are located between the two side walls 34c and 34g. The walls 34d, 34d and 34f are arranged parallel to the side walls 34c and 34g and, like the side walls 34c and 34g, are arranged to interconnect the upper and lower surfaces 34a and 34b. In this manner, four bays, referenced 40a-d, are formed between the

upper and lower surfaces and adjacent pairs of walls 34c-g. The front and rear of each of the bays, in the Y axis, is open. In this manner, reservoirs may be inserted into the bays from one side and fluid and electrical connections may be made between the reservoirs and the printer at the other, as is described below.

As can be seen from the Figure 2a, a single conventional reservoir 28a-d is located in each bay 40a-d. Associated with each bay is a slider assembly. Each slider assembly has a slider element 36a-d and connected to it a slider release tab 38a-d. Each slider element 36a-d is arranged to slide in and out of its corresponding bay 40a-d along the Y axis. Each slider element is constrained to follow grooves (not shown) located in the walls 34c-34g, located on either side of that slider element. In the present embodiment, the slider elements are manufactured out of any suitable plastic material. In this manner it may be ensured that the slider elements 36a-d slide freely relative to the housing 34 without the need for special bearings or lubrication.

As is described below, the slider elements are arranged to support and locate the reservoirs correctly in their respective bays, facilitating the installation and removal of reservoirs designed for use in conjunction with the printer of the present embodiment.

In the present embodiment, each of the bays 40a-d has the same internal form and dimensions. In the present embodiment, the bays 40a-d are sized in order to allow a selected models of ink reservoir to be inserted into the bays along the Y axis in a loose sliding fit. In the present embodiment, as is conventional in many inkjet printers, the ink supply reservoirs are pressurised in use in order to facilitate the transport of ink from the reservoirs to the printheads. Thus, in the present embodiment, the size of the bays is chosen to permit easy installation of the reservoirs in the bays whilst preventing the reservoirs from expanding overly, particularly in a direction perpendicular to the Y axis, when pressurised. In this manner, the structural rigidity required to resist the expansion of the reservoirs may

be incorporated into the housing 34 instead of the reservoirs themselves. Thus, the cost and weight of the replaceable reservoirs may be reduced.

The reservoirs 28a-d shown in Figure 2a, may be termed in the present embodiment "high volume reservoirs". In the figure, the reservoirs 28a-d are each illustrated in their installed position. By this, it is meant that they are correctly mounted in the adaptor unit for use in printing. In this position, such high volume reservoirs may extend slightly in the positive Y axis direction from the walls 34c-g of the housing 34.

Referring now to Figure 2b, a similar view of the adaptor unit 30 to that shown in Figure 2a is illustrated. However, in Figure 2b, a conventional "low volume reservoirs" 28a'-d' is shown in its installed position in each of the bays 40a-d. As can be seen from the figure, the low volume reservoirs 28a'-d' extend less far in the positive Y axis direction relative to the housing 34 when in the installed position than do the high volume reservoirs 28a-d.

In Figure 3, a perspective view of an exemplary high volume reservoir 28a and an exemplary low volume reservoir 28a' are shown. Although not shown in the figure, both types of reservoir 28a and 28a' have the same type of interface for connection to the printer. As can be seen from the figure, the dimensions of the two types of reservoir are the same, except for their lengths in the Y direction, as indicated in the figure. In this manner the size and shape of the bays in the present embodiment is also suitable for easy installation of the low volume reservoirs. Furthermore, the bays prevent the low volume reservoirs from expanding overly when pressurised in the same manner as described above with regard to the high volume reservoirs.

It will thus be appreciated that in the present embodiment a high or low volume reservoir may be installed in any of the bays 40a-d. Furthermore, one or more low volume reservoirs may be installed in the adaptor unit 30 at the same time as one or more high volume reservoirs. An example of this is illustrated in Figure 2c. Here, two low volume reservoirs 28b' and 28d' are shown in their installed positions in bays

40b and 40d, respectively, and two high volume reservoirs 28a and 28c are shown in their installed positions in bays 40a and 40c, respectively.

Referring now to Figure 4a, a view similar to that shown in Figure 2a, of the adaptor unit 30 with high volume reservoirs is illustrated. However, in Figure 4a, the slider 36d is illustrated in its open position, with the reservoir 28d correctly located on the slider 36d. That is to say, that the slider 36d is extended in the positive Y direction so that the reservoir 28d is wholly or mostly outside of its bay. In this position, the reservoir 28d may be easily unloaded from or loaded onto the slider to allow it to be installed or replaced.

Figure 5a schematically illustrates a cross sectional view taken along the lines A-A in Figure 4a of the slider 36d, the slider release tab 38d, the reservoir 28d and the lower surface 34a of the housing 34. As can be seen from Figure 5a, the slider 36d has a number of recesses 42a-e located in its upper surface, as viewed in the figure. The lower surface of the reservoir 28d, as viewed in the figure, has a number of bosses or features 44a-c. When the reservoir 28d is correctly positioned on the slider 36d, the bosses 44a, 44b and 44c are located in the recesses 42a, 42b and 42e of the slider 36d, respectively. The location of the bosses 44a-c in the corresponding features of the slider 36d secures the reservoir 28d to the slider 36d in a predetermined position relative to the slider 36d. Thus, the reservoir connections 52a of reservoir 28d' are located at a predetermined position along the Y axis relative to the slider 36d.

The user may remove the reservoir 28d located on the slider 36d by lifting it up from the slider 36d, in the positive Z direction. Alternatively, the user may install the reservoir 28d so that it is correctly connected for printing simply by pushing the slider 36d in the direction of the arrow B shown in the figure. This may be done, in the present embodiment, by pushing the slider release tab 38. Thus, the slider 36d and the reservoir 28d move relative to the lower surface 34a of the housing 34, until they reach the position shown in Figure 6a.

As can be seen from Figure 6a, the reservoir 28d is now in its installed position in the adaptor unit 30. In this position, the slider 36d is fully retracted into the housing 34. The position of the reservoir 28d relative to the slider 36d has been maintained due to the interaction of the bosses 44a, 44b and 44c of the reservoir 28d and the recesses 42a, 42b and 42e of the slider 36d. The electrical and fluid connections required between the reservoir 28d and the corresponding connections 46 of the ink delivery system of the printer 10 have been made. In the present embodiment, the connections 46 of the ink delivery system of the printer are resiliently mounted in the Y axis; in this case using one or more conventional springs (not shown). This allows the force with which the user is required to push the slider 36d in order to make the connections between the reservoir 28d and the printer ink delivery system to be regulated. In this manner, it may be ensured that sufficient force is applied to make the connection, whilst limiting excess force, which might otherwise damage the system.

As can be seen from the figure, a hook 48a is mounted on the slider about a pivot axis 48b. As the slider 36d approaches its fully retracted position, the hook contacts a cam surface or lip 50a associated with the lower surface 34a of the housing 34. As the user continues to push the slider assembly towards the fully retracted position, the hook 48a rides up over the lip 50a against a biasing spring (not shown). As the skider continues to move in the negative Y direction, the hook, which continues to be biased downwards by the spring force as viewed in Figures 5a and 6a, engages with a recess 50b located in a surface of the lower surface 34a of the housing 34. When the user hears or feels this locking engagement, he intuitively understands that the reservoir 28d is installed. The engagement of the hook 48a in the recess 50b, then secures the slider 36d together with the reservoir 28d in the installed position against the biasing spring force of the ink delivery system connections 46. In this manner, the electrical and fluid connections between the reservoir 28d and the ink delivery system connections 46 are maintained at a predetermined force even once the user releases the slider release tab 38d.

In the present embodiment, the slider release tab 38d is, like the hook 48a, arranged to pivot about the pivot axis 48b. As the slider release tab 38d is pulled in the direction of the positive Y axis, the slider release tab 38d rotates about the pivot axis 48b in the direction of arrow C shown in Figure 6a. This has the effect of raising the hook 48a relative to the recess 50b, by virtue of a conventional camming system (not shown). Continued force applied to the slider release tab 38d in the direction of the positive Y axis, causes the slider assembly, which is no longer restrained by the hook 48b, to move in the direction of the positive Y axis. In this manner, the reservoir 28d is disengaged from the ink delivery system connections 46 and returned to the position shown in Figure 5a. Thus, in the present embodiment, one simple control, pushing or pulling the slider release tab 38d, may be used to install or uninstall the reservoir 28d.

It will be appreciated that the high volume reservoirs may be installed or uninstalled installation from the other bays 40a-c in the same manner. This will therefore not be further described.

Referring now to Figures 4b, 5b and 6d, the installation and removal of a low volume reservoir 28d' from the bay 40d will now be described.

Referring now to Figure 4b, a view, similar to that shown in Figure 2b, of the adaptor unit 30 with low volume reservoirs is illustrated. However, in Figure 4b, the slider 36d is illustrated in its open or extended position, with the reservoir 28d' correctly located on the slider 36d. As can be seen from the figure, however, the reservoir 28d' is separated from the slider release tab 38d by a much greater distance than was the case with a high volume cartridge 28a-d. Similarly, however, the reservoir 28d' is wholly or mostly outside of its bay when correctly located on the slider 36d in its extended position. In this position, the reservoir 28d' may be easily unloaded or loaded onto the slider to allow it to be installed or replaced.

Figure 5b schematically illustrates a cross sectional view taken along the lines A'-A' in Figure 4b of the slider 36d, the slider release tab 38d, the reservoir 28d' and the

lower surface 34a of the housing 34. As can be seen from Figure 5b, the lower surface of the reservoir 28d', as viewed in the figure, has a number of bosses or features 44a'-c', which correspond to those features 44a-c of the high volume reservoir 28d. When the reservoir 28d' is correctly located on the slider 36d, the boss 44c', which is adjacent the reservoir connections 52b, is located in the recess 42e of the slider 36d. Thus, the reservoir connections 52b of reservoir 28d' are located in the same position along the Y axis relative to the slider 36d as were the reservoir connections 52a of reservoir 28d, despite the difference in the lengths in the Y axis between the high and the low volume reservoirs.

Due to the difference in length between the high volume and the low volume reservoirs, the remaining bosses 44a' and 44b' of the reservoir 28d' are located in different recesses to those occupied by the bosses 44a and 44b of the high volume reservoir 28d. As can be seen from Figure 5b, the bosses 44a' and 44b' of the reservoir 28d' are located the recesses 42c and 42d respectively in the upper surface of the slider 36.

As was described above with reference to Figure 5a, the user may remove the reservoir 28d' that is located on the slider 36d by lifting it up from the slider 36d, in the positive Z direction. Alternatively, the user may install the reservoir 28d' so that it is correctly connected for printing simply by pushing slider release tab 38 in the direction of the arrow B shown in the figure until the reservoir 28d' is correctly installed; as is illustrated in Figure 6b. The user may then uninstall the reservoir 28d' by pulling the slider release tab 38. These processes function as described above with regard to the installation and removal of the high volume reservoir 28d, and so will not be described further.

As was described above, the reservoir connections 52a and 52b of the high and low volume reservoirs are located at the same position along the Y axis relative to the slider 36d when their respective reservoirs are correctly located on the slider 36d. Consequently, the force with which the user is required to push the slider 36d to correctly install either a high or a low volume reservoir against the spring force of the

spring mounted connections 46 of the ink delivery system of the printer is the same. It will be understood that this allows a simple and reliable connection to be established in the same way for both reservoir types.

Further Embodiments

In the above embodiment numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent however, to one skilled in the art, that the present invention may be practiced without limitation to these specific details. In other instances, well known methods and structures have not been described in detail so as not to unnecessarily obscure the present invention.

For example, although the above-described embodiment functions with two sizes of ink reservoir, it will be appreciated that in other embodiments a different number of reservoir sizes may be employed. This number may be three, four or indeed any reasonable number. It will be appreciated that such embodiments may require merely further recesses in the slider elements in which the bosses of the further reservoir sizes may be located.

In the above-described embodiment, certain boss/recess combinations used to locate a reservoir on a slider were common to the different reservoir sizes, whilst other boss/recess combinations were not common to the different reservoir sizes. It will however be understood that this may be varied in other embodiments of the invention. For example, in one such embodiment different reservoir sizes may exclusively use common boss/recess combinations. In another such embodiment different reservoir sizes may exclusively use non-common boss/recess combinations.

In the above-described embodiment, the high and low volume reservoirs had differing lengths but the same or similar cross sections. It will be understood however, that the present invention may also be applied with benefit to hardcopy systems in which the cross sections of reservoirs of different volumes are different.

Although the term reservoir has been used to describe ink reservoirs, the skilled reader will appreciate that other substances may be stored in such reservoirs; for example a conventional ink fixer substance.

It will be understood that in other embodiments of the invention, the number of ink reservoirs employed may differ from that described above. Any reasonable number of ink reservoirs may be employed; for example, one, two, three, or five or more.

Although in the above description the slider was arranged to move linearly between the reservoir loading position and the installed position, the skilled reader will appreciate that in practice this need not necessarily be the case. For example, the slider or other reservoir support device may instead by arranged to follow a curved path, or to rotate between these positions.

Furthermore, although in the above-described embodiment the slider was arranged to move substantially the same distance between the first and second positions when loading both the high and the low volume supplies, it will be appreciated that this may be varied in other embodiments. For example, in other embodiments the interfaces of reservoirs of different volumes may be arranged to be located at different points relative to the slider element.

It will also be understood that although the above-described embodiment was described as being an inkjet printer, the present invention may be applied with benefit to a wide range of hardcopy systems. These may include inkjet copiers for example, non-inkjet copiers, or other non-inkjet devices.